

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-2

Study No.: 436

Title: Vital Statistics of walleyes in Saginaw Bay

Period Covered: October 1, 2000 to September 30, 2001

Study Objective: To determine exploitation, abundance, growth, mortality, movement, and recruitment for the walleye population in Saginaw Bay.

Summary: A total of 2,997 walleyes *Stizostedion vitreum* were tagged in 2001 in the Tittabawassee River. The sex composition of walleyes collected for tagging in 2001 was again skewed towards males. Between March and December 2000, 15 reward tags were returned by anglers, yielding a correction factor of 2.85 for non-reporting. A total of 239 tags were reported by anglers in 2000, representing 14 year classes. The tag recovery software, ESTIMATE was again used to analyze tag returns. The tag recovery rate was 2.97 percent for 2000, yielding a corresponding corrected exploitation rate of 8.5%. Total annual survival for 1998 (the most recent year estimated) was 47.5%. Age and growth analysis is pending scale aging.

Job 1. Title: Tag walleyes.

Findings: In 2001, a total of 2,997 serially-numbered monel tags were applied to the jaws of walleyes captured below Dow Dam on the Tittabawassee River, a tributary to Saginaw Bay (Table 1). Walleyes were collected with 230-volt DC electrofishing gear. We used a single boat and one or two tagging crews. Over 1,000 walleyes were typically tagged per day. Tagging spanned about four days of work in late March. The collection effort also doubled as a spawn collection opportunity for the Michigan state hatchery system. Fingerlings and fry reared from spawn collected from Tittabawassee River walleyes are used for stocking in the Lake Huron watershed. The 2001 tagging effort brings the study total to 71,094 walleyes tagged since 1981 (Table 1).

Biological data were collected from all walleyes handled as part of the tagging program. Fish were measured for total length (mm). Tagging was limited to fish meeting or exceeding the 381-mm minimum length limit in the fishery. Fish were externally sexed: mature males were ripe and easily identified; fish identified as females could have included some immature individuals of both sexes. Scales were taken from all walleyes tagged. A subsample of these scales from the height of the run was aged. A single day of scale collection was selected for aging when the sex ratio most closely approximated 1:1.

Job 2. Title: Determine tag correction factor.

Findings: The tagging effort in 2000 included 300 monel tags that indicated a \$100 reward for their return. The return rate of these tags with the added monetary incentive, was 2.85 times that of the tags without a reward. This value constitutes a correction factor for non-reporting by anglers. The correction factor was applied to the 2001 tag recovery rate estimates to estimate exploitation rate. This correction factor will be similarly applied to future results from this study.

All anglers returning or reporting a tag were sent a letter of explanation and appreciation. This practice has been in place since the inception of the study. Anglers producing a reward tag had a check included with their letter. A similar study is underway in Lake Erie. The Great Lakes Fishery Commission is coordinating dispensing of Michigan Department of Natural Resources reward funds for both projects.

Job 3. Title: Analyze data and prepare performance and final reports.

Findings: The composition of walleyes collected from the spawning migration in the Tittabawassee River was strongly skewed towards male fish in 2001 but is considered to be an artifact of sex specific spawning migration patterns and not necessarily representative of the overall sex ratio in the population. Mean total length of fish from the spawning migration has not changed appreciably in recent years (Table 2).

Analysis of age structure and the corresponding growth rate of walleyes in the spawning migration has not yet been performed for 2001. The age structure of walleyes from the 2000 migration reflects the maturing of the population. Mean age increased in 2000 for female fish but plateaued for males (Table 3). The 1992, 1993, and 1996 year classes continue to make a weaker showing in the age structure in 2000 relative to those ages in previous years. Until the 2001 analysis is complete, the contribution of the strong 1997 and 1998 year classes to that year’s migration is not clear.

Growth rate of walleyes in the spawning migration, as determined by mean length-at-age, is very fast compared to the state average reported by Schneider et al. (2000) (Table 4). The fast growth rate of Saginaw Bay walleyes, which has long been documented under Michigan Federal Aid Study 466, indicates the population is well below carrying capacity of the bay’s habitat and forage base (Fielder et al. 2000). Walleye growth rate has been a primary means of evaluating the status of recovery of the Saginaw Bay walleye population (Fielder et al. 2000). This analysis will be updated with the 2001 data upon completion of the scale aging.

In 2000, a total of 239 tags, spanning 14 year classes, was reported by anglers (Table 5). Using the tag-recovery program, ESTIMATE–Model 1 (for year-specific survival, fishing, and reporting rates) (Brownie et al. 1985), the following values were estimated.

1999 recovery rate (percent)	2.97
95% confidence interval	2.39-3.55
1998 survival rate (percent)	47.5
95% confidence interval	34.03-60.92
Mean adult life span after tagging (years)	2.39
95% confidence interval	2.28-2.50

Recovery rates reported here and in Table 5 represent year-specific rates from the ESTIMATE analysis and are the most up-to-date values. These may differ slightly from values previously reported for this study. The mean recovery rate for all years since 1984 was 3.39 (Table 5). Similarly, survival estimates used to determine total annual mortality rate (Table 6) are year specific and improve with reporting over time. Exploitation rate was estimated by expanding the year-specific recovery rate by a correction factor (for non-reporting) of 2.85, determined from Job 2 of this study.

Exploitation of walleyes in Saginaw Bay returned to a lower level in 2000 after an increase in 1999 (Table 6). The decrease, however, occurred at a time when the open water sport fishery showed a slight increase in harvest (G. Rakoczy, Michigan Department of Natural Resources, personal communication). Total annual mortality derived from the ESTIMATE survival estimates increased sharply in 1999, the most recent value calculable with ESTIMATE (Table 6). This increase in total annual mortality probably reflects the increased exploitation that year as well as the fishery's heavy dependence on only a few year classes. Age structure of the walleye harvest in Saginaw Bay (Michigan Federal Aid Study 427; Rakoczy, Michigan Department of Natural Resources, unpublished data) is depicted in Table 6. The weak 1992, 1993, and 1996 year classes were fully recruited to the fishery. The strong 1997 year class had recruited to the fishery by 1999 but the even stronger 1998 year class had not.

More background and the history of this study can be found in Keller et al. (1987) and Mrozinski et al. (1991) who summarized results through 1988. Fielder et al. (2000) summarized results from 1989 through 1997 and related the findings to other work on Saginaw Bay including movement based on tag returns.

Analysis of the 2001 fishing season tag returns will take place early in 2002.

Literature Cited:

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Table 1.—Number of walleyes tagged in the Saginaw Bay system, by site, Saginaw Bay watershed 1985-2001.

Site	Year																	Study total ^e
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 ^d	2001	
Tittabawassee River																		
Dow Dam	3,335	2,923	6,020	4,036	2,494	2,488	3,079	2,995	2,989	2,999	2,970	2,992	2,993	2,490	2,999	3,299	2,997	59,205
Sanford Dam	531	608	-	-	497	-	-	-	-	-	-	-	-	-	-	-	-	1,636
Other rivers																		
Kawkawlin River	-	-	56	-	74	-	-	-	-	-	-	-	-	-	-	-	-	368
AuGres River	174	59	215	-	-	-	-	-	-	-	-	-	-	-	-	-	-	448
Saginaw River	-	-	-	115 ^a	-	418	-	-	-	-	-	-	-	-	-	-	-	533
Flint River ^b	-	-	-	-	-	-	-	-	-	-	-	-	-	2,994	2,997	2,993	-	5,991
Saginaw Bay																		
Consumers Power	-	0	-	-	207	-	-	-	-	-	-	-	-	-	-	-	-	217
Pt. AuGres	60	511	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	914
Catfish Hole ^c	-	529	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	529
Pinconning	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56
Sand Point	-	-	1,108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,197
Total	4,100	4,630	7,399	4,151	3,272	2,906	3,079	2,995	2,989	2,999	2,970	2,992	2,993	5,987	5,996	6,292	2,997	71,094

^aTagged on May 7, 1988, in Saginaw River at Wickes Park during a walleye tournament.

^bReturns analyzed and reported separately and not included in estimate model analysis.

^cA 19-foot deep depression about seven miles southwest of Pt. AuGres in Grid 1507 (includes 98 tagged).

^dIncludes 300 reward-tagged fish.

^eTotal number since study inception in 1981.

Table 2.—Average total length (mm) of walleyes collected by electrofishing below Dow Dam, Tittabawassee River, March-April 1981-2001.

Year	Female		Male		Total	
	Length	Number	Length	Number	Length	Number
1981	528	87	350	272	394	399
1982	516	179	452	513	467	697
1983	549	2,082	498	1,300	528	3,413
1984	584	1,052	472	2,421	505	3,540
1985	531	1,322	457	1,662	490	2,984
1986	536	1,370	465	2,023	493	3,574
1987	546	1,736	472	3,829	485	5,976
1988	582	549	477	3,338	490	4,033
1989	561	1,774	485	1,244	528	3,064
1990	582	972	493	1,481	528	2,467
1991	584	2,232	488	843	559	3,079
1992	610	1,491	483	1,497	556	2,995
1993	582	1,323	488	1,666	531	2,989
1994	599	1,452	531	1,534	564	2,999
1995	589	962	538	2,003	556	2,970
1996	627	1,376	556	1,614	589	2,992
1997	630	1,905	554	1,088	604	2,993
1998	589	1,170	544	1,311	564	2,489
1999	620	957	549	2,031	569	2,995
2000	630	531	540	2,756	555	3,299
2001	635	576	518	2,421	540	2,997

Table 3.—Age composition (percent) of walleyes sampled from Tittabawassee River (Dow Dam) during spring electrofishing, 1988-2000.

	Age														Mean age
	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	
1988															
Female	—	—	4.0	18.5	32.8	25.7	10.5	5.7	3.0	—	—	—	—	—	5.5
Male	—	0.5	29.5	22.8	25.5	14.5	3.8	2.3	1.1	—	—	—	—	—	4.5
1989															
Female	—	—	1.5	41.4	27.3	23.1	5.7	1.1	—	—	—	—	—	—	4.9
Male	—	0.8	5.8	58.5	20.4	8.2	4.4	1.2	0.6	—	—	—	—	—	4.5
1990															
Female	—	0.1	0.1	1.2	37.1	34.7	22.9	3.6	0.4	—	—	—	—	—	5.9
Male	—	3.1	5.0	14.0	49.2	21.1	7.1	0.5	0.1	—	—	—	—	—	5.0
1991															
Female	—	—	0.1	18.8	19.2	45.7	11.5	2.6	1.5	0.6	—	—	—	—	5.7
Male	—	0.1	43.8	9.6	19.6	20.5	3.6	2.6	0.2	—	—	—	—	—	4.4
1992															
Female	—	0.1	0.0	9.4	14.5	12.1	17.9	13.7	10.2	12.9	4.6	3.0	1.7	0.2	7.5
Male	—	0.6	19.5	30.8	17.4	17.6	11.4	1.0	1.0	0.3	0.4	—	—	—	4.8
1993															
Female	—	—	1.6	13.7	31.8	11.7	18.6	14.6	6.5	1.2	0.3	—	—	—	6.1
Male	—	—	33.3	25.6	14.2	12.6	9.0	2.9	1.1	1.3	—	—	—	—	4.6
1994															
Female	—	—	1.3	17.3	32.7	16.0	7.7	12.2	7.7	1.9	1.3	0.6	—	—	6.0
Male	—	—	4.9	18.9	12.8	10.4	13.4	17.1	12.8	4.9	1.2	—	—	—	6.5
1995															
Female	—	—	—	9.4	53.1	13.4	9.1	7.1	3.9	2.4	1.2	0.4	—	—	5.8
Male	—	—	1.3	9.0	20.5	21.0	12.7	14.0	12.5	7.6	0.7	0.4	0.2	—	6.7
1996															
Female	—	—	—	0.2	9.1	18.4	22.6	13.1	12.6	15.9	6.9	1.3	—	—	7.8
Male	—	—	0.6	0.8	6.3	16.1	18.9	21.9	18.4	13.0	3.1	0.9	—	—	7.8
1997															
Female	—	—	0.4	4.1	1.3	11.8	26.8	22.9	12.4	8.4	7.1	4.9	—	—	7.9
Male	—	—	—	1.5	0.3	15.2	23.6	27.3	16.1	9.2	4.0	2.0	—	0.6	7.9
1998															
Female	—	—	1.7	22.8	11.0	6.6	11.3	19.6	12.8	7.3	4.0	2.7	0.3	—	7.0
Male	—	—	6.8	9.3	3.4	4.8	16.4	22.7	17.7	10.3	6.2	1.5	0.9	—	7.6
1999															
Female	—	—	0.4	8.0	13.3	4.9	4.5	11.4	21.2	18.6	9.8	6.8	0.4	0.4	8.3
Male	—	0.6	1.7	13.2	8.5	5.2	7.4	23.5	19.8	12.4	4.5	1.2	0.8	—	7.6
2000															
Female	—	—	—	0.6	11.2	14.9	10.6	4.3	13.0	20.5	13.7	8.1	2.5	—	8.7
Male	—	4.4	11.7	2.2	9.0	11.4	5.8	8.2	21.8	14.1	8.3	2.5	0.6	—	7.4

Table 4.—Mean total length (mm) at age of walleyes from tagging operation, Tittabawassee River, spring 1997-2000.

Year class	Age	Male		Female		Age	Male		Female		
		Length	Number	Length	Number		Length	Number	Length	Number	
1997						1998					
1995	2	—	0	—	0	3	432	44	495	10	
1994	3	—	0	521	2	4	478	60	523	137	
1993	4	508	5	528	19	5	505	22	559	66	
1992	5	513	1	556	6	6	526	31	584	40	
1991	6	521	53	584	55	7	544	106	612	68	
1990	7	536	82	615	125	8	561	147	635	118	
1989	8	554	95	632	107	9	584	115	655	77	
1988	9	577	56	668	58	10	594	67	671	44	
1987	10	594	32	681	39	11	610	40	701	24	
1986	11	597	14	688	33	12	610	10	686	16	
1985	12	630	7	714	23	13	632	6	—	0	
1984	13	—	0	—	0	14	—	0	—	0	
1983	14	681	1	—	0	15	—	0	—	0	
1982	15	—	0	—	0	16	—	0	—	0	
1981	16	546	1	—	0	17	—	0	—	0	
Total			347		467			648		600	
1999						2000					
1998	1	—	0	—	0	2	390	32	—	—	
1997	2	394	3	—	0	3	446	84	—	—	
1996	3	430	9	500	1	4	477	16	533	1	
1995	4	481	68	525	21	5	510	65	553	18	
1994	5	515	44	559	35	6	529	82	580	24	
1993	6	530	27	585	13	7	540	42	600	17	
1992	7	543	38	643	12	8	552	59	633	7	
1991	8	562	121	643	30	9	569	157	632	21	
1990	9	582	102	663	56	10	589	102	672	33	
1989	10	597	64	678	49	11	599	60	677	22	
1988	11	604	23	699	26	12	614	18	702	13	
1987	12	608	6	708	18	13	608	4	705	4	
1986	13	610	4	—	0	14	—	—	—	—	
1985	14	—	0	—	0	15	—	—	730	1	
1984	15	—	0	—	0	16	—	—	—	—	
1983	16	—	0	—	0	17	—	—	—	—	
Total			509		261			721		161	

Table 5.—Tag return matrix for walleyes tagged at Dow Dam, Tittabawassee River, during spring, 1984-2000.

Tag year	Recovery year																	Total returns	Estimated recovery rate		
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000				
1984	69																	0	363	1.94	
1985		88																	0	337	3.21
1986			118																0	309	4.02
1987				308															1	586	4.80
1988					161														1	367	3.86
1989						68													1	239	3.40
1990							59												3	224	2.38
1991								71											2	289	2.58
1992									165										6	353	5.47
1993										150									9	311	4.79
1994											76								12	253	2.57
1995												76							8	224	2.03
1996													53						20	271	2.60
1997														76					18	246	3.12
1998															87				24	186	3.40
1999																92			36	162	4.04
2000																	126		98		
Mean																					3.39
Total	69	200	281	515	380	268	188	223	438	375	210	162	226	306	311	395	239	4,818			

Table 6.—Walleye year class percent composition in Saginaw Bay sport fishery, harvest (2 SE of the mean), adjusted annual exploitation rate, and total annual mortality rate, 1989 through 2000.

Year class	Creel Survey Year												Mean
	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
1981	—	—	0.8	1.3	0.6	0.2	—	—	—	—	—	—	—
1982	5.1	—	2.4	3.1	2.1	—	0.7	0.2	—	—	—	—	—
1983	5.1	—	6.5	4.5	4.1	1.8	1.4	2.2	0.6	—	—	—	—
1984	13.6	—	8.4	4.9	4.8	4.4	4.2	2.7	2.4	0.2	—	—	—
1985	28.8	—	14.5	10.7	12.7	8.4	8.7	7.7	3.6	1.2	—	—	—
1986	45.7	—	16.1	18.3	10.6	11.6	9.7	10.2	6.7	2.5	—	0.9	—
1987	1.7	—	12.0	11.6	7.6	9.2	8.3	6.2	6.1	3.5	0.5	0.5	—
1988	—	—	20.2	16.5	14.1	13.8	11.1	7.0	6.7	3.7	0.5	1.1	—
1989	—	—	19.1	24.6	23.0	17.6	16.3	11.7	5.2	9.6	5.8	3.4	—
1990	—	—	—	4.5	15.5	14.8	12.7	9.2	9.7	11.3	9.7	3.9	—
1991	—	—	—	—	4.9	17.8	20.3	19.0	18.2	12.5	12.3	4.6	—
1992	—	—	—	—	—	0.4	6.4	6.7	11.5	8.0	8.9	8.7	—
1993	—	—	—	—	—	—	0.2	1.2	1.2	3.3	5.8	6.2	—
1994	—	—	—	—	—	—	—	15.7	25.2	28.1	24.9	13.5	—
1995	—	—	—	—	—	—	—	—	3.0	15.4	15.0	11.6	—
1996	—	—	—	—	—	—	—	—	—	0.6	4.7	3.2	—
1997	—	—	—	—	—	—	—	—	—	—	11.8	16.4	—
1998	—	—	—	—	—	—	—	—	—	—	—	26.0	—
1999	—	—	—	—	—	—	—	—	—	—	—	—	—
2000	—	—	—	—	—	—	—	—	—	—	—	—	—
No. aged	59	—	491	224	631	500	424	401	330	512	990	438	—
Harvest ^a	56,337 (10,580)	—	61,028 (10,817)	64,447 (8,702)	125,160 (18,357)	68,170 (11,907)	47,887 (9,208)	47,566 (9,990)	78,128 (15,109)	80,366 (11,614)	42,276 (16,918)	56,598 (28,037)	61,040
Exploitation	9.3	7.2	7.0	14.9	13.1	7.0	5.7	7.2	8.8	9.5	11.5	8.5	9.1
Total mortality ^b	31.1	30.3	42.0	39.8	34.6	22.9	39.5	24.6	32.7	28.8	52.5	—	34.2

^a From previous MDNR creel survey reports.

^b Annual rate for last year cannot yet be calculated.